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NOTE ON RECENT CONTROVERSIES RESPECTING *EOZOON CANADENSE.*

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In a recent article, published in the *American Journal of Science*, I have remarked that

"*Eozoon Canadense* has, since the first announcement of its discovery by Logan in 1859, attracted much attention, and has been very thoroughly investigated and discussed, and at present its organic character is generally admitted. Still its claims are ever and anon disputed, and as fast as one opponent is disposed of, another appears. This is in great part due to the fact that so few scientific men are in a position fully to appreciate the evidence respecting it. Geologists and mineralogists look upon it with suspicion, partly on account of the great age and crystalline structure of the rocks in which it occurs, partly because it is associated with the protean and disputed mineral Serpentine, which some regard as eruptive, some as metamorphic, some as pseudomorphic, while few have had enough experience to enable them to understand the difference between those serpentines which occur in limestones, and in such relations as to prove their contemporaneous deposition, and those which may have resulted from the hydration of olivine or similar changes. Only a few also have learned that *Eozoon* is only sometimes associated with serpentine, but that it occurs also mineralized with loganite, pyroxene, dolomite, or even earthy limestone, though the serpentinous specimens have attracted the most attention, owing to their beauty and abundance in certain localities. The biologists on the other hand, even those who are somewhat familiar with foraminiferal organisms, are little acquainted with the appearance of these when mineralized with silicates, traversed with minute mineral veins, faulted, crushed and partly defaced, as is the case with most specimens of *Eozoon*. Nor are they willing to admit the possibility that these ancient organisms may have presented a more generalized and less definite structure than their modern successors. Worse, perhaps, than all these, is the circumstance that dealers and injudicious amateurs have intervened, and have circulated specimens of *Eozoon*, in which the structure is too imperfectly preserved to admit of its recognition, or even mere

fragments of serpentinous limestone, without any structure whatever. I have seen in the collections of dealers and even in public museums, specimens labelled "*Eozoon Canadense*," which have as little claim to that designation as a chip of limestone has to be called a coral or a crinoid." *

These statements were called forth by the appearance of a learned and well illustrated paper, disputing the animal nature of *Eozoon*, by Prof. Karl Moebius of Kiel, and in which, on the evidence of several specimens given to him by Dr. Carpenter and myself, he assumes that he has "investigated more closely and described more minutely" than any other naturalist, its forms and structures, and that by his labours *Eozoon* has been "successfully eliminated from the domain of organic bodies."

Since the appearance of this memoir, and of my criticism upon it, Moebius has published in the same Journal a reply, which has appended to it a note by the principal editor, closing the controversy in so far as that Journal is concerned, by stating that the editor had pledged himself that no rejoinder would be permitted. This, of course, excludes the advocates of the animal nature of *Eozoon* from any farther argument, in so far as the principal organ of scientific opinion in the United States is concerned; and it is partly for this reason that I appear at present in the attitude of a defender of *Eozoon* on its own soil, instead of, as heretofore, carrying the war into the enemy's country.

Still later than this reply of Moebius, are two additional papers of still more remarkable character. For, while Moebius is content to take up a purely negative position, these undertake to account for the structures of *Eozoon* by other causes than that of animal growth, and by causes altogether inconsistent with one another. The first of these is an abstract of a memoir "On the origin of the mineral, structural and chemical characters of Ophites and related rocks," presented to the Royal Society of London by Professors King and Rowney. The second is a quarto pamphlet of 96 pages with 30 plates, by Dr. Otto Hahn, entitled "Die Urzelle,,' the "Primordial cell."

I confess I do not regard either of these papers as of any scientific value, in so far as *Eozoon* is concerned, but as they are at least bold and confident in their tone, and emanate from quarters which may be supposed to give them some little influ-

* Amer. Jour. of Science. March, 1879.

ence, I think it well to notice them along with the reply of Prof. Moebius.

Moebius has thought proper to take advantage of the security guaranteed to him by the Editor of the American Journal, to reply to my courteous and somewhat forbearing criticism, in a manner which relieves me from any obligation to be reticent as to his errors and omissions. I shall, however, confine myself to those points in his rejoinder which seem most important in the interest of scientific truth.

1. With reference to the geological and mineral relations of *Eozoon*, I cannot acquit Moebius of a certain amount of inexcusable ignorance. More especially, he treats the structures as if they consisted merely of serpentine and calcite, and neglects to consider those specimens which, if more rare, are not less important, in which the fossil has been mineralised by Loganite, Pyroxene and Dolomite. If he had not specimens of these, he should have procured them before publishing on the subject. He neglects also to consider the broken fragments of *Eozoon* scattered through the limestones, and the multitudes of *Archæosphærinæ* lying in the layers of deposit. Nor can I find that he has any clear idea how the structures of *Eozoon* could have been produced otherwise than by living organisms. Still farther, he makes requirements as to the state of preservation of the proper wall and canal system which would be unfair even in the case of Tertiary or Cretaceous *Foraminifera* injected with Glauconite, how much more in the case of a very ancient fossil contained in rocks which have been subjected to great mechanical and chemical alteration.

2. In his reply he reiterates the statement that *Eozoon* is so different from existing *Foraminifera*, that, if this is a fossil, we must divide all organic bodies into "1. Organic bodies with protoplasmic nature (all plants and animals); and 2. Organic bodies of Eozoonic nature (*Eozoon*, Dawson)." Without referring to the somewhat offensive way in which this is stated, I need only say that Dr. Carpenter has well replied that the structures of *Eozoon* are in no respect more different from those of modern *Foraminifera* than those of many other old fossils are from their modern representatives. All palæontologists know, for example, that while we cannot doubt that *Receptaculites*, *Archæocyathus*, and *Stromatopora* are organic, and probably Protozoan, it has proved most difficult to correlate their structures with those of modern animals.

3. I took occasion to mention certain errors of Prof. Moebius, due to his limited information on the subject of which he treats. He admits two of these, which were particularly pointed out, but taunts me with not producing others. This, however, would not have been difficult had I been disposed to enter in detail into a task so ungracious. Another example may be taken from his plate XXXV, in which he represents together, and obviously for comparison, portions of the pores or tubuli of the modern *Polytrema*, and an imperfect fragment of the proper wall of *Eozoon*, and this more especially, as appears in the text, to show the comparative fineness of the latter. But the specimen of *Eozoon* is magnified only 75 diameters, while that of *Polytrema* is magnified 200 diameters, or in the proportion of 5625 to 40,000. Again he has affirmed and repeats in his reply that the casts of the canal systems of *Eozoon* do not present cylindrical forms but are "*flat* and *irregular* branched stalk-like bodies." If they appeared so to him, he must have possessed most exceptional specimens. Some canals, especially the larger, no doubt have flattened forms, particularly at their points of bifurcation; but this is comparatively rare, more especially in the vastly numerous minute canals which are more frequently filled with dolomite than with serpentine. I have indeed been able to detect only a few out of very numerous specimens in which the majority of the casts of canals are not approximately round in cross section, even in the case of the larger canals. It is a question also if some flattening may not be due to pressure; and there are flat stolon-like tubes which can scarcely be called canals.*

It occurs to me here to remark that Moebius seems to have overlooked the extremely fine canals injected with Dolomite that fill the upper and thinner calcite walls of the better preserved specimens, and which in the thinner walls are nearly as fine as the tubuli of the proper wall, into which in many cases they almost insensibly pass where these last are themselves filled with dolomite. Possibly these structures have not been present in his specimens, or may have been destroyed or rendered invisible by his methods of preparation, and if so this would account for

* The forms of the canals are perhaps best seen in decalcified specimens; but Mr. Weston, who has done so much toward this investigation, has managed to cut slices so accurately at right angles to the general course of groups of canals, as to show their round cross sections with great distinctness.

some of his conclusions. These fine canals are best seen in well-preserved serpentinous specimens free from chrysotile veins, and etched with very dilute nitric acid. They have scarcely been done justice to in any of the published figures either of Dr. Carpenter or myself, and do not appear in those of Prof. Moebius.

4. In reply to my objection that he has confounded the proper wall of *Eozoon* with veins of chrysotile, and that both are represented in his figures, he challenges me to point out which of the latter are chrysotile and which proper wall. Of course doing so will be of little importance to the argument, but I may indicate his figs. 18, 43, 44 and 48 as in my opinion taken from portions of proper wall, and fig. 45 seems to show the proper wall along with chrysotile. I may farther now point out to him that even Profs. King and Rowney in their recent paper admit that the proper wall is not continuous chrysotile, but consists of "aciculæ separated by calcareous interpolations," though they try to account for this structure by complicated changes supposed to have occurred in veins of chrysotile subsequently to their deposition.

In truth, the chrysotile veins cross all the structures of *Eozoon*, and those specimens are best preserved which have suffered least from this subsequent infiltration of chrysotile into cracks formed apparently by mechanical means. This has been amply shewn in figures which I have already published, but I have now still more characteristic specimens which I hope may yet be engraved.

5. Prof. Moebius sneers at my statement that when the proper wall of *Eozoon* is merely calcareous and not infiltrated, its structures are invisible, and that in many cases it has become opaque, while in thick slices its structure is always indistinct; but he should know that this is the case with all fine organic tubuli or pores in fossils penetrated with mineral matter, and eminently so with fossil Nummulites, as the researches of Carpenter have long ago demonstrated, and as any one possessing slices of these fossils can see for himself. I may add that in some decalcified specimens in my possession, where the proper wall has been wholly of calcite, it is indicated merely by an *empty band* intervening between the serpentine cast and the supplemental skeleton filled with casts of canals.

6. Lastly, he seems to think that no offence should be taken at his insinuation that the figures printed by Dr. Carpenter and myself are idealized or untruthful representations, and he repeats the accusation in the following terms: "The individual peculi-

arities of diagrams should not exceed the limits of the known variability of the real specimens, but in the *Eozoon* diagrams of Carpenter and Dawson these limits are exceeded." There could not, I think, be a more plain charge of wilful falsification, and this is made by a naturalist who discusses *Eozoon* without having taken the pains either to study it *in situ*, or to avail himself of the large collections of specimens which exist in England and in Canada. I can only reply that while I have been unable to figure all the peculiarities of the canal systems of this complicated and often badly preserved fossil, I have endeavoured to select the most characteristic specimens; and that my representations are principally, nature-prints, photographs, and camera tracings, some of the latter by artists in no way interested in *Eozoon*. Dr. Carpenter's representations appear to me to be equally truthful. Neither of us have taken the trouble to represent badly preserved or imperfect specimens, any more than we should do so in the case of any other fossil, when better examples were procurable.

In connection with this, Moebius seems to think that in my criticism I should have gone into all the details into which he enters. This was unnecessary, except to expose his principal errors or mis-statements. It could not have been done without publishing a treatise as long and as expensively illustrated as his own; and this I should prefer to do in some other form than as a mere reply to him; and with reference to much larger and more varied collections than those at his command. It is to be hoped that his expectations will be satisfied in this respect by a monograph which Dr. Carpenter proposes to undertake.

He is good enough to add that if I will send him more and better specimens, he will willingly "forgive" me for "disappointing" him and other naturalists. I must say that I cannot purchase forgivenness on such terms, but if he will take the trouble to visit Canada and inspect my collections, he shall have every opportunity to do so.

I think it is only due to the interests of palæontological science to add here, that I attach more blame to the editors of the German publication "Palæontographica," in which his memoir appears, than to Prof. Moebius himself. We have been in the habit of regarding this publication as one in which the matured results of original observers and discoverers are given, and when it devotes 40 costly plates to the labours of a naturalist who is not of this character, in so far as *Eozoon* is concerned, and who has

not even studied the principal collections on which other naturalists equally competent have based their conclusions, they incur a responsibility much more grave than if they were merely the conductors of a popular scientific journal, open to cursory discussions of controverted points. They cannot relieve themselves from this responsibility till they shall have published a really exhaustive description of *Eozoon* by some one of the original workers on the subject. This is the more necessary, since if *Eozoon* is really a fossil, its discovery is one of the most important in modern palæontology, and since its claims cannot be settled except by the most full investigation and illustration.

The second paper referred to above contains little that is new, being a re-habilitation of that hypothesis of "Methylosis," or chemical transmutation, which the authors have already fully explained in the Transactions of the Irish Academy and elsewhere. Its bearing on *Eozoon* is simply this:—that if any one acquainted with geological and chemical possibilities can be induced to believe that the Laurentian limestones of Canada are "Methylosed products," which originally "existed as gneisses, hornblende schists, and other mineralised silacid metamorphics," he may be induced also to believe that *Eozoon* is a product of merely mineral metamorphism.

When we consider that these great limestones have been so fully traced and mapped by Sir William Logan and his successors on the Geological Survey; that some of them are several hundreds of feet in thickness and traceable for great distances, that they are quite conformable with the containing beds, and themselves exhibit alternating layers of limestone and d lomite, with layers characterized by the presence of graphite, serpentine, and other minerals, and subordinate thin bands of gneiss and pyroxene rock, the idea that they can be products of a sort of pseudomorphism of gneisses and similar rocks, becomes stupendously absurd, and can only be accounted for by want of acquaintance with the facts on the part of the authors.

To explain the structures of *Eozoon*, however, even this is not altogether sufficient, but we must suppose a peculiar and complex arrangement of laminae, canals, and microscopic tubuli or fibres simulating them, to be produced in some parts of the limestones and not in others; and this by the agency of several different kinds of minerals.

In other words we have to suppose a conversion on a gigantic

scale of gneiss into dolomite, limestone, graphite, serpentine, and other minerals, consisting for the most part even of different elements, and this at the same time or by still more mysterious subsequent changes, producing imitations of the most delicate organic forms. The mere statement of this hypothesis is, I think, sufficient to show that it cannot be accepted either by chemists or palæontologists, and it only serves to illustrate the difficulties which *Eozoon* presents to those who will not accept the theory of its organic origin.

Dr. Otto Hahn regards the matter from an entirely different point of view. He has himself visited Canada, has collected specimens of *Eozoon*, and now proposes to effect an entire revolution in our ideas of the palæontology of the Eozoic rocks.

In a former paper he had maintained that *Eozoon* is altogether of mineral origin, that its serpentine is hydrated olivine, and the canal system merely cracks in calcite injected by the expansion of this mineral. This hypothesis he now finds untenable, and he regards *Eozoon* as a vegetable production, or rather as a series of such productions. He regards the laminæ as petrified fronds of a sea-weed, and the canal systems as finer algæ of several genera and species. Not content with this, he describes as plants other forms found in granite, gneiss, basalt, and even meteoric iron, and others found included in the substance of crystals of Arragonite, Corundum and Beryl. All these are supposed to be algæ of new species, and science is enriched by great numbers of generic and specific names to designate them, while they are illustrated by thirty plates representing the quaint and grotesque forms of these objects, many of which are obviously such as we have been in the habit of regarding as mere dendritic crystallisations, cavities, or impurities included in crystals.

Among other curious discoveries the author refers to a plant which he honours me by naming *Photophoba Dawsoni*, and which he discovered in certain "amoeba-like" nodules of flint found in the Silurian of Montreal, and used to adorn the grounds of McGill College. I was puzzled for some time by this, until it occurred to me that at the time of the Doctor's visit some English gravel had been laid on our College terrace, and that several heaps of large irregular flints from this gravel had been gathered in front of the buildings. These had apparently afforded the new plant in question. Some other plants stated to be found in hornblende from Montreal mountain, and in limestone said to be called "fancy stone," are more difficult to account for.

All this plant theory, advanced with the utmost confidence, has no evidence whatever except the assertion of the author and his belief as to the imperfect character of the observations of his predecessors. The following extracts, kindly translated by our colleague Dr. Sommer, will serve to show his mode of treatment:—

"I was convinced of the inorganic nature of Eozoon, or at least of the fact that it could not be an animal. But the fine "canal systems" as Dr. Carpenter had named them, were the source of much anxious thought on my part, and this was necessarily augmented by the following consideration, of which I could not rid myself. "Gneiss is formed by water and therefore a sedimentary rock. Its layers of limestone must contain the first organic enclosures; for, life cannot begin with the silurian rocks." This is a hypothesis, but, like many others that are true, one of which I have not yet rid myself."

"It happened, then, that I had to go to Canada, in consequence of an invitation from the Canadian Government.* I visited Dr. Dawson and thence went to Côte St. Pierre, Petit Nation, there I saw the stratified layers and obtained a great number of pieces of Eozoonic Limestone and of Eozoonic specimens. On my return I examined the material. The result of my examinations I publish here: *the Limestone of the Laurentian Gneiss of Canada, the oldest sedimentary strata of our earth, contains a plant organization belonging to the family of the Algæ.*"

"Till now there have been but few new species established different from the modern; but, I am persuaded, that by continual researches, the number will soon be increased. All these plants, I found enclosed in the *true* "Eozooic Rock," which I shall henceforth call *Eophyllic Limetone.* I shall draw attention to the words that my honorable friend Dr. Dawson also used: "all is not Eozoon!" †

Then follows a description, condensed from Canadian reports, of the Laurentian formation, after which occur the following statements:—

"It is incomprehensible that on looking upon this form, a plant did not occur to the mind, at once. It can only be explained thus: that, at first, when such pieces were not yet discovered, they were so prepossessed by the idea of Foraminifera, that it pervaded all their investigations; while the opponents, (myself included) arrived at once at the obvious conclusion; namely that not being animal it was therefore mineral."

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* Dr. Hahn seems to have been employed on some mission connected with emigration from Germany.

† This, I suppose, refers to the fact that I warned Dr. H. that he would find the greater part of the Laurentian limestone to be destitute of distinguishable Eozoon.

"I found the species which I first called *Eophyllum* in a piece of *Eozoon*, in the first white band of limestone overlying a layer of serpentine; in other words between two layers of serpentine. Then first this question occurred to me: Are not the whole lumps of Eozoon plants? I was forced to yield to the inference after I had exposed, by applying Hydrochloric acid to the limestone, some larger lamellæ which were in connection with serpentinic layers; indeed, the forms are so permanent and so constantly reappearing that they cannot be explained otherwise. Of course with this there was gained the best argument against the animal theory; for, hitherto the discovered species of Algæ have never been found in either stones or shells. This plant belongs to the family of the Algæ. They either rest immediately upon dolomite and gneiss, or, are found in the proper Eophyllous limestone, i. e. in the layers of serpentine limestone, between the large strata of dolomite and serpentine. They are, however, not only to be found in the limestone, but also in the serpentine of the strata. No plants or but few, are found in the thick layers of serpentins which enclose the Eophyllous limestone; certainly none in the lowest. Some of them may be seen with the naked eye, while with the microscope, we come to the smallest conceivable forms. Being replaced by silicates, they may be exposed by the application of acid to the limestone. This done, the plants make their appearance as shining white stems, calyxes, and leaves. In thinly ground plates, they appear a yellowish brown. This, probably, is the reason that Möbius describes their color as being a light brown. In reality, it is the refraction of the light in the opaque masses." *

"There was scarcely ever a more difficult task given to natural science, than the determination of the nature of "*Eozoon*." When I made my first announcement of *Eophyllum* in the "Ausland" I little thought that the large ribbons of serpentine were also plants. I had already half-finished this work after my original plan, when I came across a defective specimen of rock, in which, in consequence of its defectiveness, the serpentine parts were very clearly distinguishable.

"I looked at it over and over again, till it struck me that the sarcode-chambers were nothing but cells of plants. Thus the fate of the microscopist is decided. What others can see with the naked eye he does not see at all. Then came the more difficult part: the examination of the case. Now, I had no more doubt. And in this manner only facts become clear. The ribbons of serpentine which constitute that which is called *Eozoon*, belong to an alga with broad leaves—if the expression is permitted—which radiating from one point arranges itself in regular forms. The basal-cell rests upon serpentine or dolomite. Roots I found only in one case, of which, however, I am not sure. The limestone is the replacing-material. The germ-cells

* Thus far, the author refers principally to the serpentine casts of the canal system.

are still visible in it, for in ground pieces for the microscope they still shine through. This may be proved by dissolving the limestone by means of acid. Here the leaves are perfectly covered with germ-cells, the "warzenansatze" of Gümbel. This is still clearer wherever the plant has been altered into dolomite. The brood-cells are then visible without the aid of the microscope. There appear, also, calyx-like cells, clear as water, which have weathered out upon the dolomite.

"But by far the most beautiful are the limestones in which the plants are changed, partly into serpentine, and partly into mica. The same cells are observed in a spar, changed into copper and malachite, visible to the naked eye. The canal-systems, therefore, of the "intermediate skeleton" are the microscopical plants which, partly, are simply of a limestone nature or have grown firmly upon large algæ, or are deposited there, dead. As I remarked in the beginning, a key to this new creation is, at all events, necessary. I say new, for it is entirely new to our imagination. The microscopical forms constitute this key. Now from these safe premises we may easily come to a conclusion; but I must here caution against the exclusive use of ground microscopical plates.* It is only by mere accident that, by this means, a view is gained; hundreds of them may be made, but only a very trained eye can decipher them."

It seems scarcely necessary to criticise the above statements, as it is probable that very few naturalists will be disposed to accept the supposed plants described by Dr. Hahn as veritable species. It may be observed, however, that in regarding the thick plates of serpentine, interrupted, attached to each other at intervals, penetrated by pillars of calcite, and becoming acervuline upward, as fossil algæ, he disregards all vegetable analogies; while in supposing that the calcite is a filling, and that the delicate fillings of canals contained in it are fine thread-like algæ, he equally asserts what is improbable. Farther, no vegetable structure or remains of carbonaceous matter have been discovered in the serpentine. Had he discovered these supposed vegetable forms in the graphite of the Laurentian, this would have been far more credible.

Hahn's paper, however, suggests one or two points of interest respecting *Eozoon*, which have perhaps not been sufficiently insisted on. One of these is the occurrence of rounded "chamberlets" in the calcareous walls. These are his "germ-cells,"

* If this is intended to apply to Canadian and English students of *Eozoon*, it is quite inaccurate, as they have always employed decalcified specimens as well.

and they sometimes present the curious character that they are hollow vesicles of serpentine filled with calcite, and when these have been cut across in making a section, and the calcite has been dissolved out with an acid, they present very singular appearances. They may in some cases have been germs of *Eozoon*, or smaller foraminifera of the type of *Archæospherinæ*, overgrown by the calcareous walls. It is farther to be observed, as I have also elsewhere remarked, that the serpentine filling the larger spaces between the calcareous laminæ sometimes shows indications of deposit as a lining of the cells, and in some specimens this lining has not filled the original space but has left a drusy cavity afterwards filled with calcite.

Again, in parts of the canal system, especially when filled with dolomite, there occur little disc-like bodies or trumpet-shaped terminations of canals. These, I fancy, are the calyx-like objects figured by Hahn. Their precise significance is not known, further than that they may represent the expanded ends of canals. Another appearance deserving of notice is the occurrence of portions of specimens of *Eozoon* in which little or no serpentine occupies the chambers. In this case the laminæ have either been pressed close together, or the chambers have been filled with calcite not distinguishable from the walls, in which, however, the casts of groups of canals often occur, and might then be more readily mistaken for algæ than when they occur between laminæ of serpentine.

Lastly, I have recently found in a specimen of *Eozoon*, structures which may possibly indicate contemporaneous plants. I have previously remarked the occurrence of deep pits or cylindrical cavities in some specimens of *Eozoon*, and have supposed that they might be of the nature of oscula. Those now referred to are, however, more definite than any previously observed. They are cylindrical perforations penetrating the whole thickness of the mass, and filled with calcite. One of them is simple, another seems to bifurcate. They are about an eighth of an inch in diameter, and present indications of alternate swellings and contractions. In approaching them the plates of serpentine split into two, and then unite, forming a continuous close wall of sarcode. This proves that these tubes are not perforations of any boring animals. They must be either definite canals penetrating the mass while living, or must represent cylindrical stems of algæ or other perishable organisms, around which the *Eozoon*

has grown. As they are only exceptionally seen, the latter supposition is perhaps the more probable. Peculiarities of this kind, to which perhaps heretofore too little attention has been given, are of some importance with reference to the controversies respecting *Eozoon*.

It may be said, in connection with the attacks in question, that if *Eozoon* is an object of which so many and strange explanations can be given, it is probable that no certainty whatever can be attained as to its real nature. On the other hand it is fair to argue that, if the opponents of its animal nature are driven to misrepresentation and to wild and incoherent theories, there is the more reason to repose confidence in the sober view of its origin, consistent with its geological relations and microscopic characters, which has commended itself to Carpenter, Gumbel, Rupert Jones, Sterry Hunt, and a host of other competent naturalists and geologists. For my own part the arguments adduced by opponents, and the re-examination of specimens which they have suggested, have served to make my original opinion as to its nature seem better supported and more probable; though of course I would be far from being dogmatic on such a subject, or claiming any stronger conclusion than that of a reasonable probability, which may be increased as new facts develop themselves, but cannot amount to absolute certainty until the discovery of Laurentian rocks in an unaltered state shall enable us to compare their fossils more easily with those of later formations.

In point of fact, the evidence for the organic nature of a fossil such as that in question, is necessarily cumulative, and depends on its mode of occurrence and state of mineralisation, as well as on its general form and microscopic structure; and it is perhaps hopeless to expect that any considerable number of naturalists will be induced to undertake the investigations necessary to form an independent opinion on the subject. It may be hoped, however, that they will fairly weigh the evidence presented, and will also take into consideration the difficulty of accounting for such forms and structures except on the hypothesis of an organic origin.